state participation in federal programs, status of state Universal Service programs, and characteristics of established state Universal Service programs. Key informants in each state were also asked to identify activities related to the provision of advanced information services such as video/cable, Internet, etc. Since the key informants are not directly involved in the regulation of these advanced services, they generally provided very limited, second hand information. However, one important exception involved rate cases where the Commission used its regulatory authority over local telecommunication companies as a means for enhancing the development of advanced information services. In a number of states, the Commission had used rates case findings and excess earnings as a vehicle to require a carrier, usually the BOC, to provide resources to increase the capabilities and access to advanced information services. Listed below are the states and, in brief, the programs they developed:

- In Arkansas, overearnings are to be used to upgrade infrastructure for hospitals and schools.
- California PUC is seeking Federal authority to use US Funds to for advanced information applications.
- Colorado set up a telecommunication trust fund for distance learning which is funded by the BOC.
- The District of Columbia had the BOC install ISDN lines in all schools.
- Georgia is requiring Bell South to spend $500,000,000 over five years for infrastructure improvements including distance learning and telemedicine applications.
- Indiana has mandated that the BOC spend $130,000,000 on infrastructure development and a grant program for distance learning - $5,000,000 per year is for schools, libraries, and government agencies.
- Kansas is having Southwestern Bell provide interactive video to all schools in the state.
- Maine has mandated that NYNEX spend $14,000,000 per year on infrastructure upgrades and $4,000,000 per year is to go to education.
- Michigan is requiring Ameritech to use its excess earnings to link schools to the Internet.
- In Missouri, SW Bell will fund special projects including "Telecommunity Centers."
- Oklahoma is having SW Bell upgrade the infrastructure in schools and provide access to the Internet.
- Pennsylvania is having the BOC hook-up schools and hospitals to the Internet.
- South Dakota is requiring US West provide local call access to the Internet.
- Texas assessed providers $150,000,000 per year for advanced infrastructure and applications.
- Wisconsin required providers to install fiber optic connections to all secondary schools in the state.

Participation in Federal Universal Service Programs

The federal government has three programs states can voluntarily participate in to promote Universal Service in their state -- Lifeline, Link-up America, and High Cost (USF) programs. Lifeline and Link-up America are targeted towards low income groups, while the High Cost fund is targeted to LECs in rural areas. Since these programs are voluntary, all states do not participate in all programs. Table 4 shows states' participation in the federal programs and related demographic data. The key informants provided the information on participation, while the demographic information was from the U.S. Census. Thirty-nine states and DC participate in the Lifeline program, while 45 states and DC participate in Link-up America. Arizona participates in both programs. Three were reasons given by those not participating.

- The state does not have the authority to mandate participation in a voluntary federal program.
- The state can not provide matching funds required by the program and cannot require the LECs to provide matching funds (i.e., Lifeline).
- The state is prohibited from validating income information required by the program.

Thus, in the case of these programs, lack of participation has little to do with the need for subsidized rates or reduced hook-up charges for low income households, and more to do with general statutory barriers. Some states that do not participate in these programs now are considering changing the law to allow participation, especially in those states contemplating the creation of a state Universal Service Fund. They may require LECs to participate in federal programs as a prerequisite to participation in a state program.

Table 4: State Participation in Federal Programs

State	Percent on Public Assistance	Percent Below Poverty Level	Federal Lifeline Program	Federal Link-Up Program	Proportion Rural	Subscribers Per Sq Mile	Federal High Cost Program
Alabama	7.10%	17.10%	Yes	Yes	39.6%	13.6	Yes
Alaska	6.70%	10.00%	Yes	Yes	32.5%	0.3	Yes
Arizona	6.40%	15.10%	Yes	Yes	12.5%	2.6	Yes
Arkansas	6.80%	17.40%	Yes	Yes	46.5%	9.6	Yes
California	10.70%	15.80%			74.0%	5.8	Yes
Colorado	5.00%	10.60%	Yes	Yes	17.6%	1.4	Yes
Connecticut	6.00%	9.40%	Yes	Yes	20.9%	na	
Delaware	5.20%	7.60%			27.0%	na	
Dist. of Col.	13.30%	20.30%	Yes	Yes	0.0%	na	
Florida	6.80%	15.30%	Yes	Yes	52.0%	13	Yes
Georgia	8.50%	17.80%	Yes	Yes	36.8%	13.9	Yes
Hawaii	5.90%	11.00%	Yes	Yes	11.0%	na	
Idaho	3.20%	15.00%	Yes	Yes	12.6%	0.7	Yes
Illinois	7.90%	15.30%		Yes	15.4%	9.9	Yes
Indiana	5.00%	11.70%		Yes	35.1%	12.9	Yes
Iowa	5.00%	11.30%		Yes	39.4%	8.5	Yes
Kansas	4.60%	11.00%		Yes	30.9%	4.6	Yes
Kentucky	9.80%	19.70%		Yes	48.2%	15.7	
Louisiana	10.20%	24.20%	Yes		31.9%	10.7	Yes
Maine	7.60%	13.40%	Yes	Yes	55.4%	11	Yes
Maryland	6.00%	11.60%	Yes	Yes	18.7%	77.1	
Massachusetts	7.50%	10.00%	Yes	Yes	15.7%	91.6	Yes
Michigan	9.00%	13.50%	Yes	Yes	29.5%	11.7	Yes
Minnesota	5.70%	12.80%	Yes	Yes	30.1%	6.8	Yes
Mississippi	11.80%	24.50%	Yes	Yes	52.9%	8.2	Yes
Missouri	6.80%	15.60%	Yes	Yes	31.3%	9.0	Yes
Montana	5.40%	13.70%	Yes	Yes	47.5%	0.5	Yes
Nebraska	4.20%	10.30%		Yes	33.9%	2.3	Yes
Nevada	3.60%	14.40%	Yes	Yes	11.7%	0.5	Yes
New Hampshire	3.40%	8.60%		Yes	49.0%	30.9	Yes
New Jersey	6.10%	10.00%		Yes	10.6%	387.2	
New Mexico	8.00%	21.00%	Yes	Yes	27.0%	0.5	
New York	9.00%	15.30%	Yes	Yes	15.7%	21.8	Yes
North Carolina	7.20%	15.70%	Yes	Yes	49.6%	30.0	Yes
North Dakota	4.30%	11.90%	Yes	Yes	46.7%	1.4	Yes
Ohio	8.70%	12.40%	Yes	Yes	25.9%	17.8	Yes
Oklahoma	6.40%	18.40%	Yes	Yes	32.3%	4.6	Yes
Oregon	5.20%	11.30%	Yes	Yes	29.5%	2.9	Yes
Pennsylvania	6.90%	11.70%	Yes	Yes	31.1%	36.9	Yes
Rhode Island	8.00%	12.00%	Yes		14.0%	na	
South Carolina	6.70%	18.90%	Yes	Yes	45.4%	25.8	Yes
South Dakota	4.60%	14.80%	Yes	Yes .	50.0%	1.4	Yes
Tennessee	8.60%	17.00%	Yes	Yes	39.1%	16.0	Yes
Texas	6.30%	17.80%			19.7%	2.4	Yes
Utah	3.80%	9.30%	Yes	Yes	13.0%	0.6	Yes
Vermont	7.20%	10.40%	Yes	Yes	67.8%	23.1	Yes
Virginia	4.80%	9.40%	Yes	Yes	70.6%	15.0	Yes
Washington	6.90%	11.00%	Yes	Yes	23.6%	11.6	Yes
West Virginia	9.70%	22.30%	Yes	Yes	63.9%	8.9	Yes
Wisconsin	6.90%	10.80%	Yes	Yes	34.3%	13.6	Yes
Wyoming	5.20%	10.30%	Yes	Yes	35.0%	0.2	Yes
U.S. TOTAL	**7.60%**	**14.5%**	**40**	**46**	**24.8%**	**4.4**	**42**

According to the key informants, 42 states, including Arizona, participate in the federal High Cost program (USF). The predominate reason for LECs not participating is the state is not a high cost state. This typically means the state is small with a predominately urban population and/or they have no LEC (often they only have one LEC) with costs above 115% of the national average. Thus, barriers to participation in this program have less to do with statutory constraints and more to do with the LECs need for support.

Status of State Universal Service Programs. Key informants were asked a series of questions about the current status of any state Universal Service programs, and any pending actions related to Universal Service. Based on this information, five categories were developed to characterize the status of different state efforts with regard to Universal Service. The categories, referred to as "Status" in Table 5, are:

1. **No statutes, regulations, or commission orders mandating Universal Service**. States in this category did not have a mandate for Universal Service at this time. However, this did not mean the state was not considering a state Universal Service program, or that it did not have a general statement to promote Universal Service. In fact, almost all states falling in this category were actively investigating Universal Service, and determining whether it should be mandated. In many cases these states were studying Universal Service as a part of, or as an off-shoot of, a docket on local competition. Nineteen states fell into this category.
2. **Mandated Universal Service in initial stages of rule making process**. States in this category had a statute or commission order mandating Universal Service, and they were in the early stages of the investigative process. Five states fell into this category.
3. **Mandated Universal Service actively involved in rule making process**. States in this category had a mandate for Universal Service and were actively involved in developing rules related to Universal Service, again often as a part of, or extension of, a docket on local competition. Many of these states had legislative mandates to develop proposed rules for Universal Service, and were given specific time frames for completion. This category included nine states.
4. **Mandated Universal Service rules with approved rules, fund not in place**. States in this category had essentially finished the rule making process, and were waiting for final legislative approval to set up a state Universal Service fund. Two states, Wisconsin and Wyoming, were in this category.
5. **Mandated Universal Service rules with approved rules, fund in place.** States in this category had a mandate, rules and an approved state Universal Service Fund in place. However, these are not newly established funds, but are typically existing funds established in the late 80's. So, while the 16 states in this category have a fund in place, all except one, are in some stage of revision or modification. Nevada is the only state in this category finished this rule making process, and they have yet to collect or distribute Universal Service Funds. These states would fall into categories 2, 3, or 4, if they had not previously established a state Universal Service Fund. And like states in those categories, the redesign of the existing programs has been triggered by deregulation and local competition.

Besides showing the status or each state's Universal Service program, the relevant statutes, regulations or commission orders are cited in Table 5. In addition, the status of local competition and the date is was permitted is presented. This information was gathered from the FCC's report on Common Carrier Competition and updated by seven key informants on their draft state profiles. A brief summary of pending actions related to Universal service is also presented. More detailed descriptions of pending actions are included in each state profile (Appendix E).

Description of State Universal Service programs.

Eighteen states have approved Universal Service programs in place. These states and descriptions of their programs are shown in Tables 6 and 7. With the exception of state penetration rates, the information was gathered through key informant interviews and examination of commission orders and regulations. Penetration rate data is from the FCC's 1993/4 Statistics of Communication Common Carriers. Like the federal programs, state Universal Service programs generally target two different groups -- LECs in high

Table 5: Status of State Universal Service Programs

State	Status	State Statute	Commission Order	LEC competition permitted	Pending Activities Related to Universal Service
Alabama	1			8/95	APSC has docket and workshop on US.
Alaska	2	4205.145	R-94-5	policy barrier	APUC has a rule making docket to adopt US. Statute allows for creation of USF for long distance service.
Arizona	5		Contel Rate case	7/95	ACC has draft rules to establish a new USF that is more structured and rule based
Arkansas	5	23-17-304		prohibited	Statute gives commission authority to continue or change the USF. The APSC hasn't held hearings.
California	5	Moore Univ. Act 1983	84-04-053 PU Code 871	7/95	The CPUC has a major rule making investigation and is looking at a complete revision of the US program.
Colorado	5	House Bill 1335		5/95	Colorado has a high cost fund in place, but is currently developing revised rules for new act.
Connecticut	5	Section 16247		7/94	The dominant LEC is proposing a creation of a high cost fund. The CPUC is reviewing the proposal.
Delaware	1			no regulatory barrier	Delaware has a general statement to promote universally available and affordable service but not a US program.
District of Columbia	3		Rate case #850	statutory barrier	The PSC is looking at US as part of a new rate case.
Florida	2	CHAP 364.025		6/95	The FPSC just completed evidentiary policy making proceedings on an interim US mechanism.
Georgia	3	Sen Bill 137		7/95	The GPSC is in process of developing rules for a USF.
Hawaii	3	Act 225 1995		6/95	The HPUC has opened a docket and issued draft rules on competition and Universal Service.
Idaho	5	62-610 1988		prohibited	The IPUC has nothing pending regarding US, but a task force is looking at Idaho's telecommunications law.
Illinois	5	13-801		1988	Staff is filing proposed rules for US. They expect to be done by April, 1996.
Indiana	5	8-1-2.6		no regulatory barrier	The IURC is in the middle of a workshop on local competition, and is reviewing the US program.
Iowa	1			5/95 (never prohibited)	They are looking at US as part of a docket on local competition.
Kansas	1			no statutory barrier	The KCC has an active docket examining US in Kansas.
Kentucky	1			policy barrier	The KPSC has a docket on local competition that includes US and a USF. They expect to finish in 1997.
Louisiana	3		V-20883-Sub Docket A	prohibited	The Commission has proposed regulations for local competition which includes a mandate for US.
Maine	2	Title 35A, PT7, CH71		no regulatory barrier	The MPCU is considering polices to establish local competition which may lead to consideration of US.
Maryland	1			1994	US may be a commission case in future due to local competition.
Massachusetts	1			1991	US is one part of a pending docket on local competition. The MPUC should have a decision in March, 1996.
Michigan	1			1991	The MPSC has nothing pending regarding US.
Minnesota	3	Chap 156, S.F. No 752		8/95	Legislature required Commission to develop rules for US. The statutory dealine is August, 1997.
Mississippi	5		77-3-35	policy barrier	The MPSC opened a docket for local competition which will include US. They will hold hearings in 1996.

(Table 5 Continues on Following Page)

Table 5: Status of State Universal Service Programs (Continued)

State	Status	State Statute	Commission Order	LEC competition permitted	Pending Activities Related to Universal Service
Missouri	1			prohibited	The MPSC has a docket on local competition which may bring up the issue of US.
Montana	1			not prohibited	A task force is looking at the issue of US. They may addresss this issue as part of local competition.
Nebraska	1			not prohibited	The NPSC has a docket on US, and are in the comment stage. They also have a docket on local competition.
Nevada	5		RO63-95	5/95	They just adopted new omnibus telecommunications regulations that includes a Universal Service Fund.
New Hampshire	2	SB-106		8/95	The NHPUC has a docket on local competition and they are currently doing background research.
New Jersey	1			under consideration	The NJBPU has nothing pending regarding US.
New Mexico	5	63-9A-6.1		1985	The NMCC will be opening up a docket on local competition which may involve US.
New York	3		94-C-0095	1992	DPS has a docket on local competition and one part of it involves US.
North Carolina	1			1995	The NCUC has a docket on local competition and US. Interim rules are due 12/31/96, final rules by 7/1/98.
North Dakota	1			no regulatory barrier	The NDPSC has minimal jurisdiction over telecommunications. Nothing is pending regarding US.
Ohio	3	ORC 497-202 1988		8/95	The PUCO has a docket on local competition with US being a key part. Staff is now developing comments.
Oklahoma	1			possible statutory barrier	The Commission has a docket on local competition and draft rules, and US is a part of that docket.
Oregon	5	759-1103	95-1103	1993	Oregon has completed Phase I of a docket on US. Phase II will create the funding mechanism.
Pennsylvania	3	House File 518	Docket No 1-940035	yes	The PPUC has a Universal Service docket, and they expect to have their policy in place by Summer 1996.
Rhode Island	1			yes	RIPUC has nothing pending regarding US. They do have a docket on local competition.
South Carolina	1			possible statutory barrier	The SCPSC is just forming a task force to look at local competition. The task force will address US issues.
South Dakota	2	49-31-4.1 1988		yes	SDPUC has nothing pending regarding US.
Tennessee	3	Sec 65-5-207		1995	The TPSC has established a proceeding on local competition and is developing rules for US.
Texas	5	1987		1995	TPUC is currently revising rules for its high cost fund.
Utah	5	54-86-11&12		1995	Utah is revising its US program and expects to be done by September 1996. They have an interim USF.
Vermont	5	Chap. 87		no regulatory barrier	VPSB has a US program in place and is developing a formula for distributing high costs funds.
Virginia	1			1995	VCC does not have a docket on US now, but will after they issue rules on local competition.
Washington	5		U-85-23	1994	WUTC is developing a position paper on US and a USF in response to a LEC's request.
West Virginia	1			no regulatory barrier	WV is considering US as part of a docket on local competition, and they have formed a task force to look at US.
Wisconsin	4	S196.218 1994	1-AC-155	yes	The PSC has submitted rules to the legislature for their US program. The program is to start January, 1996.
Wyoming	4	37-14-501		1995	The PSC has nearly finished its rule making process for US, and the Governor will sign the rules within 60 days of final adoption.

cost areas and low income/economically disadvantaged households. Sixteen of the eighteen states with programs, are targeted at LECs in high cost areas, and eight are targeted to low income/economically disadvantaged. Seven states have programs targeted at just high cost LECs and only one state (Connecticut) is targeted at just low income/economically disadvantaged. Colorado, Texas, and Wisconsin have programs for users with disabilities, while Vermont has targeted emergency services and Wisconsin has targeted homeless and advanced services to schools and health care organizations.

Programs that are targeted at high cost areas are not portable, while programs targeted at low income/ economically disadvantaged, or users with disabilities are portable. That is, for these later groups the subsidy goes with the individual; if the person moves to another carrier's exchange, the subsidy moves to the new carrier. Portability should not confused with whether the individual gets a voucher or credit on their bill or not, or whether the funds go to the LEC. It is possible to have a voucher or credit go to a customer in a high cost area, even though it isn't portable. One informant suggested the idea of including a credit or voucher in high cost areas, so the customers would realize the subsidy they were receiving, even though it wasn't portable. Another interviewee suggested their state's high cost program should be modified so that only those who needed a high cost subsidy would get it -- that wealthy individuals would

Table 6: Description of State Universal Service Programs

State	Status	Penetration Rate	Targeted Groups	Administration	Is subsidy portable?
Arizona	5	94.1%	Rural/high cost	BOC	No
Arkansas	5	90.0%	Rural/high cost	BOC	No
California	5	95.2%	Rural/high cost Low income/economically disadvantanged	Independent 3rd party	Yes, for low income
Colorado	5	95.7%	Rural/high cost	Commission	No
Connecticut	5	96.4%	Low income/economically disadvantanged	LECs (changing to 3rd party)	Yes
Idaho	5	94.8%	High cost (not stated but implicit)	Independent 3rd party	No
Illinois	5	93.5%	Low income/economically disadvantaged Rural/high cost	Non-profit organization; LEC Assoc.	Yes, for low income
Indiana	5	92.9%	Rural/high cost	BOC	No
Mississippi	5	88.7%	None	BOC	No
Nevada	5	92.8%	Rural/high cost	Independent 3rd party	No
New Mexico	5	88.6%	Low income/economically disadvantaged Rural/high cost	Commission established board	No
Oregon	5	96.2%	Rural/high cost Low income/economically disadvantaged	LEC Assoc. (OECA)	No
Texas	5	91.5%	Rural/high cost Low income/economically disadvantaged Users with disability	LEC Assoc. (TECA)	Yes, for low income and disabled
Utah	5	96.6%	Rural/high cost	Commission	No
Vermont	5	94.7%	Rural/high cost Low income/economically disadvantaged Emergency services (911)	LEC Assoc. (NECA)	Yes, for low income
Washington	5	95.7%	Rural/high cost	LEC Assoc. (WECA)	No
Wisconsin	4	97.0%	Rural/high cost Low income/economically disadvantaged Users with disability, Homeless Advanced services to schools & health care	Independent 3rd party	Yes, for low income and disabled
Wyoming	4	92.6%	Rural/high rate	Commission	No

not receive a subsidy just because they lived in a high cost area. Doing this, would in affect make the states high cost subsidy portable. State Universal Service Funds are typically administered by an independent third party (4) or a LEC Association (5). In four states the commission is currently responsible for administering the fund, and in four the BOC administers the fund. Table 7 shows the funding mechanisms for current state Universal Service Funds. In all states except Illinois and Mississippi, LECs, the BOC and the IXCs contribute to the fund. Only six states currently require providers of wireless telecommunication services to contribute to the fund, and in all cases these are providers of cellular service. The trend in pending programs, however, is to define contributors as broadly as possible. Many states are developing mechanisms that will require wireless companies and resellers to contribute. One of the barriers these states face is they do not currently regulate wireless communication, and resellers are often located out of state. Arizona is one of the states that have defined contributors very broadly in their proposed rules to include providers of cellular, paging and commercial mobile radio services. Cable companies will also become contributors in many states once they are providers of local service. As one interviewee stated, "Any company that benefits from the network should contribute to the Fund."

States with a Universal Service Fund tend to use some variation or combination of "total revenues", "total access lines", or "total minutes of use" as the basis for determining each carriers contribution to the fund. The carries contribution is typically based on their proportion of the total for the state (i.e., what proportion the carrier's total revenues are in comparison to the total revenues for all carriers in the state). There are no distinctions made between business or residential "revenues", "access lines" or "minutes of use". Perhaps the most unique program currently in place is Illinois' program were customers can make a voluntary contribution to a fund that is used to waive installation charges to low income subscribers.

Most state Universal Service Funds provide a rate subsidy to the carrier or the customer, and even when the subsidy is for the customer, it typically goes directly to the carrier to off-set a credit on the customers bill. The trend in pending programs is to continue providing subsidies to carriers. Few states currently provide direct infrastructure reimbursement to the carriers, and when they do it is on a case by case basis. The criteria used to distribute funds is closely tied to the selected target group. Generally, programs that target rural/high cost groups distribute funds to carriers based on the carriers costs or rates being above the statewide average by some percentage. Many current programs modeled their program after the federal high cost program, providing subsidies to LECs whose unsupported NTS loop costs were greater than 115% of the statewide average. Others states based distributions on the LEC's rates being a certain percentage above the statewide (i.e., Idaho, Wyoming) or above a certain fixed amount established by the Commission (Oregon, Utah). Programs that target low income/economically disadvantaged or disabled, subsidized carriers based on the number of eligible subscribers who receive credits. Wisconsin's program is unique in that distributes "high rate assistance" based on the median income in the service area (i.e., if the rate for basic service is greater than 2% of the median income for the service area subscribers receive a subsidy). Many pending programs have yet to determine the manner in which they will distribute funds. Fund distribution is perhaps the most complex, unresolved and difficult issue in pending programs. Even those with proposed rules have yet to specify exactly how funds will be distributed.

In summary, states' Universal Service programs are generally targeted to high cost areas, and this trend continues in pending programs that are developing in response to local competition. Only a few small, urban states are focusing primarily on low income households. The selected target group, in turn, typically determines the type of subsidy and its portability, with most high cost programs providing rate subsidies to carriers. While some states use direct infrastructure reimbursement, they do not rely on this for promoting Universal Service to rural areas. There is clearly trends to broaden the base of contributors to state funds to include all telecommunication carriers that benefit from the network and to better target areas by using Census tracts for identifying high-cost areas. The greatest variation in programs, and perhaps the toughest issue is how to distribute funds. Many states are still trying to resolve this issue.

Table 7: Description of State Universal Service Funding Mechanisms

State	Contributors	Basis for Contribution	Types of Subsidies	Who Draws From Fund
Arizona	LECs, BOC, IXCs	Surcharges per access line and per minute of use on intrastate toll	Rate subsidy	LECs who demonstrate high cost (one LEC now)
Arkansas	LECs, BOC, wireless, IXCs	% of retail billed minutes of use	Rate subsidy	LECs with intrastate NTS costs per loop > 115% of statewide weighted average
California	LECs, BOC, wireless, IXCs	% of billable revenues	Carrier rate subsidy; Subsidy to customer	LECs with high cost and eligible subscribers
Colorado	LECs, BOC, IXCs	Minutes of use and access charge per line	Rate subsidy	Costs above average investment for the traffic
Connecticut	LECs, BOC, IXCs	Total gross revenues as a percent of total state revenues	Rate subsidy with subsidy going to customer	LECs with eligible subscribers Subscriber receives credits for intra and interstate service
Idaho	LECs, BOC, IXCs	Surcharge on all local access lines and each intrastate toll minute	Bulk check to carrier	LECs with rate for 1-party single line in excess of 125% of weighted statewide avg.; or avg. charge per minute for NTS/ WTS in excess of statewide avg.
Illinois	Customer contributions, and IXCs	Customer voluntary, and LEC intrastate minutes of use for high cost program	Waiver of installation charge to customer; Sliding scale subsidy to carrier for costs above statewide average	LECs based on the number of eligible PA customers; Small LECs based on average costs per access line versus statewide average
Indiana	LECs, BOC, wireless, IXCs	Intrastate carrier common originating and terminating access minutes	Rate subsidy; Direct infrastructure reimbursement; waiver of hook-up charge.	LECs with intrastate NTS costs above the statewide average
Mississippi	BOC, LECs	Minutes of use	Rate subsidy; Direct infra-structure reimbursement	13 LECs with high-cost
Nevada	All telecommuni-cation providers	% of intrastate retail revenues	Rate subsidy; Direct infra-structure reimbursement	Small LECs with rate of return below commission set level
New Mexico	No one currently	Total revenues	Rate subsidy	No one is drawing from fund
Oregon	LECs, BOC, IXCs	% of gross revenues	Rate subsidy; Direct infra-structure reimbursement	LECs who show cost shift would cause residential rates to exceed $15.00
Texas	LECs, BOC, IXCs	Access minutes of use	Rate subsidy to carrier; Equipment reimbursement; Customer rate reduction	LECs with high cost who show cause or those with eligible customers
Utah	LECs, BOC, wireless, IXCs	1/2 cent/minute NTS traffic	Direct infrastructure reimbursement, Cost of service subsidy	LECs (not BOC) whose rates equal or exceed a target rate set by the UPSC
Vermont	LECs, BOC, wireless, resellers	2% surcharge on all bills including interstate, cellular, directory assistance, 2-way cable, PCN service	Rate subsidy; Direct infrastructure reimbursement	Reimbursement to providers of TRS service; Rate subsidy to eligible customers; Direct infrastructure reimbursement to carrier for 911 upgrades
Washington	LECs, BOC, IXCs	Carriers proportion of total access minutes	Rate subsidy to eligible carriers	LECs whose unsupported loop costs is 115% of statewide avg.
Wisconsin	All providers of telecomm services with rev > $200K	% of gross revenues	Rate subsidy, Direct infrastructure reimbursement; Equip-ment reimbursement	LECs for eligible subscribers (low income and disabled); High rate assistance based on median income in service area
Wyoming	LECs, BOC, IXCs, wireless	% of gross retail revenues	Rate subsidy to carrier with credit on bill	LECs with rates above 135% of statewide average

Economic Development and the Rise of the Virtual Corporation:

> Information technology is obliterating the distinction between small business and big business. Big businesses are becoming collections of small businesses, and small companies are partnering with one another, creating virtual corporations for a given period. Many industries that have been dominated by large corporations, like the automobile industry, are becoming networks of small suppliers linked through Information Technology (IT). In the past, one of the major barriers to entry for small business into fields dominated by large players was access to information. But large companies no longer have a monopoly on information regarding emerging technologies, consumers, capital markets, or even personnel. Today, small companies can rapidly form niche markets using all this specialized information.
>
> Robert Reich, U.S. Secretary of Labor

The advances in telecommunications technology, first facsimile (fax) transmission of business notes and documents with unprecedented immediacy, the prevalence of e-mail and file transfer, and more recently the evolution of mobile computing, videoconferencing and groupware applications have proved to be substantial enablers to the efficient operation, delivery of customer service and strategic outreach and interaction of today's businesses. Large enterprises utilize these telecommunications tools to drive efficient internal operations and manage the information flows in their global organization and customer base. Smaller firms can form collaborative partnerships and offer more competitive service delivery by also employing these tools, creating a business presence and quality of service well targeted to an era of outsourcing and the rise of entrepreneurial service enterprises .

ASPED (Arizona Strategic Planning for Economic Development), the forerunner of today's Governor's Strategic Partnership for Economic Development (GSPED), in their January, 1992 report "Creating a 21st Century Economy: Arizona's Strategic Plan for Economic Development," clearly stated the issue:

> Telecommunications and access to information have taken on increasing importance as the global economy becomes more tightly connected. Invariably, the most economically successful regions of the world also possess the most advanced information and communications infrastructure. During the 1980s, a virtual revolution in telecommunications occurred as a result of the fusing of computer and communications technology. The revolution was further fueled by the breakup of AT&T and the new competitive marketplace it created. For Arizona, information and communications infrastructure may be the key to opening up whole new economic development opportunities.

This vision of Arizona's economic development, nourished by its active participation in the revolution in telecommunications, is further advanced by the January, 1995 report of the Governor's Commission for the Study of the Telecommunications and Information Industry in Arizona. The report, prepared by Network Resources, Inc. is titled "Arizona Telecommunications: Leadership through Partnership for Competitive and Innovative Information Industry." Section 2 on Telecommunications and Economic Development in Arizona analyzes in detail the historical trends and research data confirming that the need for and use of advanced telecommunication and information services is inexorably linked to economic development and that the telecommunications industry itself is a major employer and generator of economic activity. It also confirms the linkage of the availability of advanced telecommunication and information services to the presence and demands of high technology companies and that such availability remains a substantial factor in their growth, the new formation of such companies within an area and the potential for high technology business relocation to an area. The importance of such high technology businesses to the state's economy is very significant and well documented in the Governor's Commission report and elsewhere.

Rural areas can reap enormous development benefits from the availability of advanced telecommunication services that are competitive with the region's urban services and costs. Rural economic development, at a disadvantage for many traditional factors, can greatly benefit from the integration of technology and automation in its existing businesses and be aided in the development and attraction of new businesses, often diversifying the business base of a community in the process. Returning again to the January, 1995 Governor's Commission Study, we find extensive and thoughtful analysis in Section 8.3 on Telecommunications and Rural Development in Arizona authored by Edwin B. Parker including this quote:

> Telecommunications offers the promise and potential to help rural businesses overcome problems of distance and lack of economies of scale. Many rural businesses, especially information-intensive businesses, can bridge wide distances to serve an enlarged customer base, including urban customers, through advanced telecommunications technology and services. This is why many catalog sales and other "telemarketing" businesses have grown in rural areas in the past decade and why many software developers and "lone eagle" entrepreneurs have moved to rural communities. As the U.S. and Arizona economies continue the global trend to more high technology and telecommunications-dependent businesses, rural locations with good telecommunications can be economically viable.

A recent study, "Impact of High Technology Industry on the Arizona Economy," begins by describing that "Among states and cities that actively recruit businesses to relocate, high technology firms are coveted. There is good reason for this. First and foremost, the high technology industry offers high quality jobs. In addition, high technology firms tend to be export oriented and make important contributions to the balance of trade." The report, published October, 1995, was authored by Dr. Alberta Charney and Dr. Julie Leones, both of the University of Arizona in Tucson. Upon its release, Governor Fife Symington of Arizona said, "This report tells us that this is the industry that is going to carry us into the 21st century." Some highlights of the data are presented below:

Direct contribution of high technology industry to Arizona's economy (1994)

- 95,099 jobs representing 4.8% of total state employment in the following industries:
  - ♦ electronic components and computers 49%
  - ♦ aircraft and missiles 20%
  - ♦ scientific instruments (including optics) 18%
  - ♦ computer software and services 8%
  - ♦ research services 3%
  - ♦ chemicals (including biotechnology products) 2%
- $4.360 billion in employee compensation
  - ♦ $45,800 compensation (including all benefits) per employee
  - ♦ Average pay is 75% higher than average Arizona pay per employee
- $5.369 billion in foreign exports, an estimated 63% of total Arizona exports
  - ♦ 7% of high technology sales in AZ, 59% to rest of U.S.,34% are foreign exports
- $6.626 billion in total expenditures on goods and services ($2.862 billion spent in AZ)
- $5.931 billion value added to Arizona's economy (6.8% of Gross State Product)
- $250 million paid in state taxes

Total contribution of high technology industry to Arizona's economy (1994)

- 180,261 jobs representing 9% of total state employment
- $6.498 billion in employee compensation
- 9.546 billion in total value added impacts (11% of Gross State Product)
- $609 million paid in state taxes

In April, 1994, the AZTEL 2000 study "Strategic Plan for Arizona's Information Infrastructure" was published as a collaborative effort of government, University and private enterprise participants led by the Arizona Department of Administration. The report "concludes that current and future telecommunications environments are central to the economic, social, and educational growth of the businesses and people of the State, and that the infrastructure needed to support Arizona's emerging future must be flexible, dynamic, and inclusive." In regards to business and economic development, it notes "As in other modern economies, the competitive survival of Arizona's business and work force depends on both the flow of information and the infrastructure that controls that information within the State. Critical services such as government, education, manufacturing, agriculture, financial services, transportation, wholesale and retail commerce, and utilities are all becoming increasingly dependent on telecommunications for cost effective administration."

While going on to propose a vision of a coordinated Arizona's telecommunications infrastructure which has yet to be realized, the driving factors the Aztel 2000 Task Force identified remain thoroughly relevant:

- Enhanced global competitive advantage for our business clusters.
- Rapid development of quality jobs.
- Environmental, family, and business benefits from telecommuting.
- Support of our telecommunications enterprises in the global marketplace.
- Readily available government services.
- Enhanced access to health care.
- Improved public safety and emergency care.
- Improved life-long education.
- Improved economic well-being.
- North American Free Trade Agreement (NAFTA) data link for expanded commerce.
- Improved government cost, efficiency, and effectiveness.
- A balance between information access and individual privacy.
- Timely, efficient, and cost-effective introduction to and use of appropriate emerging technologies.
- Affordable telecommunications services.

The Morrison Institute for Public Policy at Arizona State University in conjunction with the Arizona Telecommunications and Information Council (ATIC - formerly the Advanced Information and Communications Infrastructure Foundation) surveyed Arizona businesses in June, 1994 on the effects of telecommunications and information issues on their individual companies and Arizona business in general. The nearly 60 businesses surveyed were from all around the state and included some of Arizona's most prominent employers as well as small, medium, and large businesses in each of the 10 industry clusters of the Governor's Strategic Partnership for Economic Development (GSPED). More than 80% of these companies, divergent in their size, location and industry, ranked telecommunications and information services as "very important" to the future success of their businesses. The majority of the companies currently use local and wide area networks, electronic mail, and electronic commerce. They also found they faced a variety of barriers to using telecommunication and information services in technical areas (incompatibility of systems, concerns for data security, complexity of technology), business rationale (difficulty in identifying return on investment), and market forces (lack of provider choice, access in their locale, regulatory barriers). The results of the survey indicated six directions for public and private entities. They are listed below, followed by selected data from the survey on Arizona business' current and planned utilization of various telecommunications technologies.

- Expand the amount and types of information and services available online from local and state government agencies.
- Promote electronic commerce in general, and "electronic data interchange" in particular, through legislation and technical assistance.
- Expand existing network information centers (such as those at the state's three universities) to increase technical assistance, information on connections, and training available to business.
- Produce a telecommunication and information "report card" regularly that rates Arizona's environment for services from the users' point of view. Use the process to monitor regulatory initiatives and developments among providers, in addition to the issues faced by current and potential provides in changing or expanding services.
- Advocate for the expansion of telecommunications infrastructure in Arizona that will allow businesses, regardless of location, to take full advantage of telecommunications and information services.
- Promote actions that will lead to reduced costs in telecommunications and information services throughout Arizona.

Table 8: Arizona Businesses - Utilization of Network Technology

	Currently Using %	To Be Used In 3 Years %	No Response %
Local Area Network	93	5	2
Internal E-mail	86	10	3
Electronic Commerce	76	21	3
Wide Area Network (WAN)	66	12	22
Commercial Services E-mail	48	24	28
Metropolitan Area Network (MAN)	24	30	47
Frame Relay	17	33	50
Switched Multimegabit Data Services (SMDS)	12	31	57
Asynchronous Transfer Mode (ATM)	10	43	47
Synchronous Optical Network (SONET)	2	36	62

(Source: Morrison Institute for Public Policy at ASU Study, September, 1994)
(From a Business Perspective: Outlooks on Telecommunications and Information Services)

Table 9: Arizona Businesses - Utilization of Telecommunications Transmission Systems

	Currently Using %	To Be Used In 3 Years %	No Response %
Modem	95	0	5
Dedicated Phone Lines	88	2	10
Wireless or Personal Communication Devices	69	21	10
Cable Systems	67	9	24
Fiber Optic Lines/Networks	66	12	22
Satellite	40	3	57
Microwave Radio Relay Systems	34	14	52
ISDN	33	26	41

(Source: Morrison Institute for Public Policy at ASU Study, September, 1994)
(From a Business Perspective: Outlooks on Telecommunications and Information Services)

Data Points, Trends and Portents:

This multi-part section is structured to illustrate the range of services and applications currently available, what role they play in today's telecommunications market, what competition may soon enter these application arenas, and what technology advances may drive their evolution. It is hoped that these brief overviews will aid the reader in grasping the complexity of telecommunications services and applications.

> People rarely distinguish among data, information, knowledge and wisdom. But they are as different from each other and as interlocking as starch molecules, flour, bread, and the flavorful memory of a superb morning croissant.
>
> Lewis Branscomb, Harvard professor and former IBM Scientist

Deregulation of the Local Telephone Market:

> Opening local phone and cable industries to vigorous competition will have a great long-term positive impact on high tech. This is especially true for America's PC industry, a world leader whose ever-more powerful machines operate over the narrowband copper phone wires and unswitched TV cables of regulated monopolies. Competition in local loops will drive investment in broadband switching networks. Additionally, state public utility commissions should complement federal reform by setting ISDN rates at POTS prices so that ISDN can serve as a bridge between narrow and broadband lines. Exploding Internet use is driving demand for ISDN lines and getting them should become inexpensive, fast and easy.
>
> Michael C. Mailbach in Upside, December 1995

Independent of federal action, many states have moved to allow competition in the local loop and more will follow in an inexorable march towards ending monopolistic control of local telephone service (see Table 10). Some consumer groups have voiced strong opposition to pending Federal Legislation that would prevent state and federal regulators from using rate of return regulation to set prices for local telephone service. The International Communications Association warns that this and even the proposed price caps, could cost consumers as much as $14 billion a year by awarding most of the benefits of technological change to telephone companies until a transition to a competitive market is complete.

Table 10: State Regulatory Commission Treatment of Competition in Switched Local Service (as of September 1, 1995)

	Competition is Allowed, Rules are in Place	Competition is Allowed, Rules are Not Yet in Place	Allowing Competition Under Consideration	Allowing Competition Not Being Considered
Firms are actively competing	IL, MI, NY, WA			
Firms have been approved for operation	CT, MD, MA, NC	AZ, OH, TN, UT		
Firms have applied for certification	CA, GA, TX	AL, FL, IA, OR, WI	KS, NJ, PA	
No statutory or generic regulatory barrier		CO, HI, ID, MN, NH, NM, NV, RI, SD, VA, WY	IN, ME, NE, OK, SC, VT, WV	DE, MT, ND
Generic policy or order is barrier				AK, MS
Statutory barrier			DC, KY (1)	AR, LA, MO

(Source : FCC Common Carrier Competition report, Fall 1995)

(Note: (1) Kentucky Public Service Commission indicates they belong one category higher up on this table, having currently a regulatory barrier, not a statutory barrier to competition.)

The glut of advertising from telcos seeking long distance customers will accelerate as they and other market entrants move to active competition for local service customers. Public and private telephone company advertising is already showing strong gains up 17.5% for the first half of 1995 to $762 million while cellular radio and phone system advertising surged 50.3% for the first half of 1995 to $141.5 million. (Source : Competitive Media Reporting)

As Local Exchange Carriers (LECs) downsize staffing to prepare for local telephone loop competition, service problems have seemingly increased in areas such as delayed installations, missing repair commitments and billing problems. Of 27 states reporting LEC staff reductions, 24 indicated an increase in service quality complaints (see Table 11). An upcoming NARUC study plans to recommend benchmark service levels, though it will be up to the individual state Public Utility Commissions whether to adopt them and how to monitor and enforce them. The importance of service quality versus lowest cost to consumers has yet to be determined in the local telephone market, but the immediate connection for customers of cellular and other wireless loop solutions may yet prove an advantage over waiting for conventionally wired service.

Table 11: Local Exchange Carriers Under Investigation for Service Quality Problems

LECs Under Investigation for Questionable Service Quality	State Public Utility Commissions Involved
Ameritech	IL, OH
GTE	AK, HA, MO, NC
NYNEX	NH (Informal Investigation), NY, RI
US West	AZ, CO, ID, IO, MN, NE, OR, SD, UT, WA

(Source: Preliminary Survey Results - National Association of Regulatory Utility Commissioners, 11/95)

The FCC assists consumers in resolving a wide variety of problems. The three most common types of complaints accounted for more than half of the estimated 21,000 received in 1994. These top three categories were: "800" calls where the initial "free call" turned into a billable call, operator service company practices and rates, and unauthorized switching of long distance service ("slamming"). The FCC is starting to compile a periodic Carrier Performance Scorecard to enhance consumer awareness of common telecommunications problems and the carriers most prone to them.

Computers and Telecommunications - More, Better, Faster, Cheaper:

Residential Telephone Subscribership Trends:

The FCC reports that in July, 1994 93.7% of U.S. households had telephones representing 92.4 million of the 98.6 million households. This was down slightly from a year earlier (94.2%) but up as a long term trend from November, 1983 rates of 91.4% penetration. The FCC also reports that in October 1993, the average for flat rate residential service was $18.82 monthly, including taxes and subscriber line charges. In most cities, consumers can subscribe to a service with a lower monthly charge than the cost of unlimited one party service. The average minimum monthly bill for such services was $11.27, including taxes and subscriber line charges. At the same time, the average business rate was a total of $42.57 monthly.

An interesting report published earlier this year by the Rutgers University Project on Information Policy was titled "Universal Service from the Bottom Up: A Profile of Telecommunications Access in Camden, NJ." The authors, Dr. Milton Mueller and Dr. Jorge Reina Schement, studied Camden with a telephone penetration level of 80.6%, well below the national average, but with racial and ethnic composition and income levels similar to other low-penetration U.S. inner cities. They explore and discredit six common myths of telephone penetration, at least for their particular study area and methodology:

- Myth #1 - That affordability of telephone service hinges on the price of local access, thus the price of basic monthly service rates should be the focus of Universal Service policy. Most marginal users are driven off the network by usage-related costs.
- Myth #2 - That Universal Service subsidies should be focused on the elderly. For age 65 and older, national penetration rate is 97%. Lowest rates are in younger age groups, especially minorities.
- Myth #3 - That maintaining Universal Service is primarily a problem for rural areas. Nationwide, penetration in rural areas is several percentage points higher than in central cities.
- Myth #4 - That low income and minority areas are threatened with "electronic redlining," in which they are systematically denied access to advanced features and services.
- Myth #5 - That telephone service is intrinsically more valuable than cable television service, because the interconnectivity function of telephone is more important than the entertainment function of cable TV.
- Myth #6 - That adoption and use of the telephone and other electronic media are insensitive to differences in race or gender.

Cable Television Enters the Competitive Arena:

Cable television originated in the late 1940s as a means to carry broadcast signals into mountainous areas where over-the-air reception was poor with a community antenna and coax cable redistribution of television signals. With increased channel capacity, over time, cable systems developed local programming and licensed additional content sources, expanding their markets through all urban and most rural areas. The National Cable Television Association (NCTA) reports that there are over 109 national and 37 regional cable networks as of April, 1995. These cable systems pass by 97% of television households capturing 63.4% (60.5 million) as basic cable households, carrying an average 40 channels of entertainment, information and community access programs.

Cable systems pay "franchise fees" to their local communities, typically 5% of revenue reaching $1.01 billion in 1993 (up from $51.2 million in 1980). The industry's Cable in the Classroom program provides over 65% of U.S. K-12 schools with free cable service and access to commercial free programming. Cable companies employ over 109,000 workers and have revenues of over $23 billion a year. Over the next five years, an estimated $24.9 billion will be spent upgrading the network with fiber optics (an estimated 69,000 miles installed to date), digital compression technology, bi-directional signal capabilities and a new generation of set-top boxes. This will allow eventual expansion of video services to interactive modes, movies on demand, voice communications and high-speed access to online services.

Indeed, existing cable systems, with their broadband capable last-mile coax passing 97% of American homes, are well staged with some strategic upgrades, to challenge the Local Exchange Carriers for basic telephone subscribership while continuing to deliver mainstay entertainment content. Cable companies will also expand into Personal Communications Services (PCS), like cellular phone service, utilizing their existing infrastructure to transmit signals from cell to cell. And they will utilize their high bandwidth capacity to enter the "private line" business market as alternative or Competitive Access Providers (CAPs). Cable modems will allow personal and business users high speed access to the Internet and online providers at multi-megabit per second speeds, hundreds of times faster than telephone modems.

But while cable expands its markets, its traditional delivery of television programming is under attack. Direct Broadcast Satellite (DBS) has emerged as a strong competitor to cable with small (18") dishes, up to 150 higher quality channels, coverage across the U.S., and ready availability at retail outlets. It is estimated that DBS will capture over 2 million subscribers by the end of this year and from 5 to 10 million by 2000. Meanwhile, local telephone companies, with new regulatory authorization, will move forward in their efforts to deliver "video dialtone" (VDT) over their infrastructure. This competition should act to constrain market prices as new strategic alliances engage the battle for the consumers video dollars.

Cellular and Other Terrestrial Wireless Expand Their Range and Services:

With a 45 percent annual growth rate, the number of U.S. cellular customers exceeded 28 million by the end of June, 1995, growing by more than 4 million users in the first half of 1995. About two out of every three new phone numbers are being assigned to cellular telephones. Average local monthly bills dropped to $52.45 per month from $58.65 a year earlier, and down 46% from 1987 when the average monthly bill was almost $100. The industry's revenue for the year through June, 1995 was $16.5 billion. In the first half of 1995, nearly 2000 new cell sites were added and a record $2.8 billion was invested for a cumulative total since 1983 of more than $21.7 billion. (Source : Cellular Telecommunications Industry Association)

At least 420 MHz of radio spectrum is being reallocated and auctioned by the FCC for Personal Communication Services (PCS) and related technologies. Compared to the 50 MHz of spectrum used by current cellular carriers (two per market), this represents the equivalent of 16 additional cellular services in each geographic market. Plus the transition from analog technology, still prevalent in most existing cellular networks, to digital with its associated compression and interference immunity, will multiply the carrying capacity of those networks. The Personal Communications Industry Association (PCIA) estimates that by 2000 there will be 14.8 million subscribers to broadband PCS services competing with traditional cellular, which is expected to have almost 50 million subscribers by then. In addition, PCS will serve an estimated 8.1 million subscribers with narrowband two-way services (i.e. - two-way and digital voice paging).

The Local Exchange Carriers will find increasing competition from these "wireless local loop" providers. A recent study by Economic and Management Consultants International projects 7 million customers will abandon traditional wired telephone service by 2002, for specially designed and priced PCS services where the mobile instrument uses a home-based cell for at-home use with automatic transfer to mobile facilities and rates when away from home. Additionally, such mobile instruments may transfer to satellite services when out of terrestrial cell site range and incorporate advanced features such as paging, voice messaging and even video conferencing.

Today 170 wireless cable operators serve 700,000 homes with Multipoint Distribution Systems (MDS) but modern wireless cable television technologies may more significantly encroach on traditional cable providers. New local multipoint distribution services (LMDS) can provide interactive video, data and voice services. Perhaps 16,000 subscribers will be served from one node serving a 6 mile radius cell. The downlink could contain 224 digital video channels and telephony with more limited uplink bandwidth available to subscribers.

Wireless is being increasingly deployed within enterprises and organizations to link Local Area Network nodes without network wiring installation and mobile business users rely more and more on wireless messaging and voice services as they roam their territory and the wider world. A very interesting proposal from Apple Computer, supported by the National Telecommunications and Information Administration (NTIA) is before the FCC. The petition requests that approximately 200 MHz of bandwidth be set aside for non-licensed low-power digital applications allowing for perhaps 20 million bit per second digital information rates at distances up to 6 miles. Digital spread spectrum technology would allow many simultaneous users to share this "citizens band" at no cost and without license, undoubtedly leading to enormous growth in wireless LANs, telemetry and other enterprise and personal applications.

Satellite Based Wireless Covers the Globe:

Satellite communications have long been the global linchpin for transport of high-capacity audio, multi-channel video, and volumes of digital data to remote locations. Home satellite reception developed to tap off the video programming flow for personal viewing until eventually portions were scrambled and licenses to receive and decrypt sold to consumers along with the necessary equipment. More recently,

geosynchronous earth orbit (GEO) satellite systems have come online specifically targeted to consumers. These Direct Broadcast Satellite (DBS) systems (or Digital Satellite Systems - DSS) employ small dishes (18"), low-cost ($600-800) receiving packages, and cable competitive rates to deliver up to 150 channels of basic and premium video programming with high quality images and audio. Federal law currently prohibits these providers from delivering programming available locally including network television, PBS and local stations unless the consumer is in an area not reached by over-the air or cable services. Thus, for now, most DBS customers retain a basic cable subscription or antenna for local broadcast reception.

Global radio communications devices for consumer use will soon be practical with the upcoming launch of the Motorola-lead consortium's Iridium and other similar systems. Iridium will soon place 66 (and competitor Globalstar 56) low earth orbit (LEO) satellites in polar orbits insuring world-wide coverage. The new mobile telephones, as discussed above, will defer to the least expensive available connection, progressing from home-based cell to terrestrial cell to satellite as necessary. At long last, there will be a system deployable in rural areas at equivalent costs of infrastructure, equipment and (to a varying degree) usage. To the extent that these satellite systems succeed in the market and costs of ownership and use are driven down, long standing rural high-cost infrastructure and service delivery issues will at last fade. More ambitious visions, such as Teledesic (backed by Bill Gates and Craig McCaw), plan for 840 satellites linked to a fixed grid of 20,000 supercells across the earth's surface enabling higher bandwidth applications from fixed and mobile customers on a global scale.

Interesting hybrid options will occur, such as Hughes' DirecPC, which via a small satellite reception dish will allow subscribers to receive a personalized stream of digital data, such as Internet downlink at 400 Kbps while simultaneously uplinking low-bandwidth navigation commands through telephone lines and their Internet access provider. Additionally, the continuing evolution of Global Positioning System (GPS) applications combined with terrestrial transmitted weather and traffic data will drive vehicular navigation and other mobile applications.

Fiber Deployment - Telecommunications at the Speed of Light:

The first commercial fiber-optic cable was introduced by Corning Glass in 1970. By 1980, 3,700 miles were deployed and exponential growth has occurred ever since. Fiber's ability to carry very high bandwidth combined with its low bulk compared to copper trunk cable has made it the transport medium of choice for telephone, cable, and utility companies alike. Fiber deployment moves ever closer to the home as telecommunications providers design their networks to deliver higher bandwidth applications to consumers, but usually stops short of actually reaching those homes, merging with existing twisted pair or coaxial infrastructure at some distance away. Large business users often receive their long distance telephone connection from their Competitive Access Providers via fiber from metropolitan loops directly into their facilities. Within business enterprises, fiber optics are being more frequently employed as Local Area Network back often to the department level and even to the desktop, especially where high-end computer workstations are used.

Public utilities often install fiber cable along their right-of-ways, driven to abandon traditional microwave connections to remote facilities by FCC reallocation of radio spectrum. Where not prohibited by their regulatory oversight agencies, they may become resellers of fiber capacity or "dark fiber." Cities and states may also benefit from leasing right-of-way access either by fees or in exchange for municipal or government use of the commercial fiber infrastructure. For example, New York State recently granted a 20 year agreement for a fiber optic network to be distributed along the Thruway to be remarketed to other communications carriers. It is expected to stimulate economic development along its path and yield 20% of the network's gross revenues in payment to the state.

From POTS to ISDN to ATM:

Plain Old Telephone Service (POTS) has been the mainstay of personal and business voice communications for well over a century. It has evolved to support many new features and functions: touch-tone dialing, 911 emergency service, facsimile (fax) document transmission, computer data transmission via modem (from an original 55 baud to 28.8 K baud today), caller identification, call waiting/forwarding, voice mail, automatic credit card authorizations and remote applications from keypad entry. The mostly analog telephone instruments and signals have connected to an increasingly digital and complex infrastructure.

Integrated Services Digital Network (ISDN) moves the essential digital conversion of voice, allowing the integration of additional data forms, back to the subscriber's instrument. In doing so, it completes the digitization of the telephone network enabling existing copper wire infrastructure to support higher information rates, transport that information in its most efficient, digital form and makes possible a host of new services and applications as well. The RBOCs have been upgrading their Central Office equipment aggressively and ISDN is now available in from 70 to 100% of their territories. An estimated 650,000 lines will be in use by the end of 1995, and many millions more in the next few years. Pacific Bell estimates that they will deploy over a million ISDN lines in California alone by the year 2000.

Still problems abound. Special new customer premises equipment is necessary at substantial cost, though those costs are dropping. Specifications for installation and configuration are complex and often troublesome to get working properly. The providers themselves are often not yet familiar enough with the technology to provide adequate support. None the less, the transition from POTS to ISDN will persist. With ISDN, Internet access can be accelerated by a factor of four as effective baud rates reach 128K. Collaborative computing and telecommuting are further enabled as voice and data can be mixed so that documents and videoconferencing transmit simultaneously with conversation. It should serve well the Small Office or Home Office (SOHO) and Work-at-Home environments, becoming ever more prevalent.

Table 12: ISDN Rates for Business

Regional Telephone Network	Installation Cost	Monthly Rates	Per Minute Rate
Ameritech	$144	$38	$.04 first, .04 +
Bell Atlantic	$98	$19.26	$.09
Bell South	$264	$111.50	surcharge
GTE	$110	$50	surcharge
Nevada Bell	$227	$80	flat rate
NYNEX	$117	$46	$.06 ($.01-$.55)
Pacific Bell	$40	$26.5	variable
SNET	$245	$33	$.03
Southwestern Bell	$485	$31	flat rate
US West	$110	$69	$.10

(Source: Dataquest, Inc., Note: Residential Rates may be lower and all rates may vary by area)

For all its improvements in digitizing basic phone service at its source and all its promise, ISDN is still the first step for the telcos on the path to deliver broadband to the home. Network transport protocols such as Asynchronous Transfer Mode (ATM) must be overlaid on digital signal communications to allow bandwidth on demand and varying priorities to be assigned to different digital message packet streams. Twisted pair capacity will not be bound by current ISDN rates, but as research and development efforts bear fruit, move into the multi-megabit ranges to allow competition with other providers for the advanced services market as it continues to develop.

Personal Computer Ownership and Modem Use:

The rise of computer sales for home use should not come as any surprise. Most parents would like their personal computer to remain personal, which means that (for those who can afford it) a second home computer has become a necessity. Frequently, the kids' computer is better than the one the parents control, loaded with "educational" features. I hear a constant stream of stories from proud parents whose son or daughter has mastered the mechanics of their machine.

Glorianna Davenport, MIT Media Lab in IEEE Multimedia Fall, 1995

Table 13: Trends in PC and Modem Ownership and Use

	1994 %	1995 %
Household has a PC	31	36
Ever use home PC	26	32
Use home PC daily	6	7
Use home PC for Personal Use	21	29
Use home PC for Work	17	18
Use home PC for School	12	12
Use a PC at Work	NA	41
Use a PC at Home	NA	10
Home PC has a Modem	12	20
Someone in House goes Online from Home	8	11
Percent of Americans who go Online from Home	6.6	8
Subscribe to Commercial Online Service	3	6
Use Internet Directly	NA	1
Connect to Office or School from Home	3.6	3

(Source: Times Mirror Center for the People & The Press, Technology in the American Household 10/16/95)

Table 14: Percentage of Households with a Personal Computer by Income and Education

Family Income	High School or Less	Some College	College Graduate
Under $30,000	14	32	43
$30,000 to $49,000	29	47	55
Over $50,000	50	62	73

(Source: Times Mirror Center for the People & The Press, Technology in the American Household 10/16/95)
(Note: Average 1995 Percentage of U.S. Households with PCs = 36%)

Table 15: Percentage of Households Who Go Online by Income and Education

(% of Population in Category / % of Computer Owners in Category)

Family Income	High School or Less	Some College	College Graduate
Under $30,000	4 / 29	15 / 47	24 / 56
$30,000 to $49,000	8 / 28	17 / 36	26 / 47
Over $50,000	17 / 34	26 / 42	35 / 48

(Source: Times Mirror Center for the People & The Press, Technology in the American Household 10/16/95)
(Note: Average 1995 Percentage of U.S. Households Who Go Online = 11%)

In the Times Mirror Center study, of the 36% of American households with PCs, 21% have had them for more than two years, 11% for less than two years, and 4% though they own a PC, don't use it. An additional 9% had a PC at one time but gave it up. The Arizona Republic and Phoenix Gazette recently commissioned a study that showed Phoenix area computer ownership of 51%, well above the 33-36% of most national polls. It also showed that 22% of the total local population goes online versus much lower national numbers. They consider the margin of error to be 4% and no specific explanation of the higher Phoenix computer and online usage is readily available without detailed analysis of the study's methodology and sample group. Other interesting data on consumer attitudes regarding local telephone and high tech services competition is also presented.

Table 16: The Arizona Poll on Telecommunications

	Yes	No	Don't Know
Do you have a computer at home?	51	49	-
Do you use the Internet or other online services such as America Online or Prodigy at home? (Note: % of 73% of computer owners with modems)	59	41	-
Do you think competition between local telephone service providers will help hold down costs to the consumer?	64	18	18
Do you think competition between local telephone service providers will speed up introduction of new high-tech advances, such as videophone service and movies on demand?	68	15	17
Would you consider using your cable-TV provider to provide telephone service?	32	42	26
Would you consider using your cable-TV provider to provide a package of services like telephone, cable TV and computer data transmission?	37	40	23

(Survey conducted for The Arizona Republic and The Phoenix Gazette, 9/22-23/95, 600 Adults)

Gordon Moore, founder of Intel, proposed more than twenty years ago that semiconductor fabrication density of transistors in integrated circuits would improve rapidly and continuously leading to a doubling of memory chip capacity about every 18 months and a doubling of effective microprocessor speed every two years. Moore's Law, as it has come to be known, suggests that the microprocessors of today at some 4 million transistors will utilize 13 million by 2001 and 90 million by 2010 in ever denser, more efficient chips. Speed, processing capability and memory size driven by ever more demanding applications tends to obsolete our business and personal computers every other year or so. The trends in increasing computer power and capacity available at reasonable cost, access to higher bandwidth through public and private networks, and implementation of better signal compression technology will converge to drive incredible advances in multimedia enabled applications incorporating virtual reality elements.

Though the demand for portable computers has soared, Personal Digital Assistants (PDAs), handheld computers, have languished. PDAs will be reenergized by PCS and other emergent wireless connectivity and may well combine with mobile telephony into a single portable computer-phone instrument. On the low end, there is much talk of new, inexpensive ($500 price point) "Information Appliances." These limited functionality computers could be used in connection with the networked information infrastructure (client-server model) to serve most individual's needs (or so the story goes). How they will fare in the market and how a new generation of cable set-top boxes will position against personal computers for control of the media hearth in the home is yet to play out. Stay tuned!

Advanced Telecommunication Applications:

If knowledge is power, then control of the kingdom of information could be at your fingertips within a decade. Flick a switch, and a video window covering a wall in your home will open up your ramp onto an ultra highspeed data highway shipping electronic bits of information at light speed. Booting up your computer, you'll cruise along hair-thin fiber optic grids. At a command, specially designed knowledge robots, your information slaves, will rocket through the supernetworks, sifting databases larger than the Library of Congress to ferret out whatever you request. The network's capability to transmit lifelike video images can electronically transport you on virtual voyages to the far reaches of the data galaxy or bring the world to your living room.

Corporations, research labs, universities and medical centers will interface through a national data highway transmitting visual and audio images thousands of times faster than today's fastest networks. These synergistic links between myriad scientists, scholars, government officials and business people should catalyze an information explosion profoundly transforming the way we live. Such a supernet could allow anyone on the data highway to harness up the power of supercomputers and provide users with calculations for complex applications such as climate modeling, stock market analysis, cosmological research and medical diagnoses and treatment.

Omni Magazine, December 1992

Table 17: Estimates of New Media Technology Markets in $Million

		1994	1995	1996	1997	1998
Commercial Online Services	(1)	795	1,100	1,600	1,800	1,700
Internet	(2)	366	771	1,500	2,400	3,700
CD-ROMs	(3)	2,500	2,800	3,100	3,300	3,500
Kiosks	(4)	292	496	823	1,400	2,200
Interactive TV	(5)	37	261	831	2,000	4,200
Infomercials/Home Shopping	(6)	2,800	3,300	3,900	4,600	5,400
Videogames(Hardware/Software)	(7)	3,800	3,900	4,000	4,200	4,300
Virtual Reality	(6)	116	190	262	374	570
Total New Media Markets		**10,706**	**12,818**	**16,016**	**20,074**	**25,570**

(Sources: (1)Forrester Research, (2) Goldman, Sachs & Co., (3) Dataquest, (4) Inteco Corp., (5) Jupiter Communications, (6)Paul Kagan & Assoc., (7) BT Securities)

Customers no longer will take merely what we give them. Customers will become powerful buyers, not just users, driving the direction of the market, not necessarily regulators or product developers. Consumer receptiveness to choice is what drives technology. Technology does not drive consumer receptiveness or choice.

There is no threat to market diversity when thousands of content providers, network access providers, manufacturers, telcos, cable companies and all the other companies are already out in the field lining up for the transition. Do not be obsessed with dividing the pie. It's making it bigger that is better for everyone. We will spend more than $20 billion in the next ten years updating our networks for tele-TV, Internet access, video phones and similar products. Although ISDN is available everywhere in our territory, you have to be pretty rich in some places to afford it. We are hoping to have 100 percent practical ubiquity for ISDN and expect major progress on the deployment.

Ivan Seidenberg, Chairman, President and CEO of NYNEX

Table 18: Consumer Online Services

	CompuServe	America Online	Prodigy	World Wide Web
Total Subscribers	3.2 Million	3.0 Million	1.2 Million	30 Million (Est.)
Average Age	42	(1)	36	35
Household Income	$93,000	$75,000	$60,500	$60,000
College Education/ Degree	94%	88%	75%	NA
Male	90%	79%	60%	82%
Female	10%	21%	40%	18%

(Source: Marketing Tools, November/December 1995)

(Notes: (1) Age 18-34=37%, 35-44=34%; Microsoft Network is estimated to have 525,000 subscribers)

Electronic Mail:

> E-mail has swept the communications and information world during the past decade, providing instantaneous global information and data exchange. People who send e-mail via the Internet - the amorphous network that links computers worldwide via telephone lines - can correspond with individuals 10,000 miles away as easily, quickly, and inexpensively as they can with neighbors next door. They can communicate with one or many people at the same time. And they can distribute information to any other user as soon as they create it.
>
> However, even though this revolution has broadened and changed the ranks of people with access to information, it has not altered one fundamental feature: An information elite still exists, made up of those with access to and knowledge about computers and e-mail. And as e-mail becomes more pervasive, as more commercial and government transactions in the United States take place online, those information haves may leave the have-nots further behind, unless we make concerted efforts today to provide all citizens with access to the technology.
>
> RAND report, "Universal Access to E-Mail: Feasibility and Societal Implications," 1995

E-mail has joined facsimile document transmission as an essential business tool and increasingly as a vital personal asset and need. It compresses time and distance in the sending of messages and is transmitted at virtually no incremental cost once the equipment and access are in place. The Electronic Messaging Association estimates that the largest 2,000 American companies employ 5 million individuals, transmitting and receiving 6.1 billion messages annually. By the year 2000, the total number of e-mail users worldwide is expected to exceed 100 million.

If any elements of the array of global information applications are to be added to an expanded range of Universal Service capabilities, it must certainly be that individuals have a electronic in-box to receive e-mail and the means to access it. Where available, Free-Nets and civic networks such as AzTeC readily provide e-mail accounts at no charge and are increasingly placing public access terminals around their regions. In some locales, state and municipal governments along with libraries have taken the lead in providing terminals and kiosks to access public records and selected information resources. In the future, they may also provide more general Internet access, allowing users to "pick up" their e-mail. Next generation consumer devices, such as TV set-top boxes and even telephones, may be e-mail enabled. Additionally, a market for "pay" terminals for e-mail and general Internet access may develop, merged with pay phones or similarly distributed. Already some coffee houses and restaurants in urban centers offer patrons computer workstations or phone jacks for portable computer attachment for these purposes. Additionally, commercial network providers may offer "free" e-mail to those willing to accept advertising messages.

Videoconferencing:

Since the widely-seen demonstrations of AT&T's Picturephone at the 1964 World's Fair, the broad availability of personal videoconferencing has been eagerly awaited. Teleconferencing between conference rooms of business people have long since proved its value in connecting remote sites in collaborative meetings, saving travel costs and time while resolving issues and advancing business objectives. The improvements in PC workstation processing capability, access to more bandwidth over corporate LANs, ISDN and other high-speed public network means, improvement in signal compression technology, and worldwide standardization of videoconferencing protocols should finally drive the market resulting in wide deployment of desktop-to-desktop or personal videoconferencing. More than just voice and visuals, documents and drawing will be viewed and annotated by multiple parties (whiteboarding) while files are transferred as background activity. Projects like ECNet (see Arizona Projects and Activities of Note below) are good examples of the value and benefits that can be obtained with the prevalence of full-featured videoconferencing. Telemedicine applications also require such capabilities along with assured security and reliability.

Consumers have been plugging their camcorders or dedicated video cameras into their own PCs and beginning to videoconference on the Internet and by direct dial interconnection. Market penetration by dedicated desktop instruments should follow. At the most recent Comdex show, Panasonic introduced a mobile handheld PCS videophone in the familiar cellular phone form factor. Signs of finally reaching critical mass for video telephony applications in the next few years look positive, but the Year of the Videophone has seemed "real close" for over 30 years now. By the way, not everyone is so anxious to participate in videoconferencing as this quote illustrates:

> In less time than Al Gore can say "national information infrastructure," they tell us, we'll all be hooking video cameras to our computers. If they're right (horrors!), we'll actually have to look at the people we communicate with online. Work-at-homers who pad around all day in flannel PJs and bunny slippers will be on display to clients; hooky-playing employees will have to look the part when they e-mail in sick; and 250-pound, balding guys from Teaneck, NJ, who've been carrying on steamy online affairs under the pseudonym Rip will be exposed for the pudgy-faced impostors they are.
>
> Zach Wolff in Netguide, April 1995

Telecommuting:

> In a country that has been moaning about low productivity and searching for new ways to increase it, the single most anti-productive thing we do is to ship millions of workers back and forth across the landscape every morning and evening.
>
> Alvin Toffler, Futurist and Author

In addition to home-based businesses, many traditionally employed workers spend part of their workweek telecommuting or are simply based by their employer at their own residence. This has a growing impact on traffic, reducing demand on transportation infrastructures and improving air quality. Employers may be able to reduce space needs and overhead, access new labor pools and comply with transportation reduction regulations with increased productivity, recruitment and retention. Employees often consider telecommuting as improving their quality of life with reduction in commute time and associated costs, increased flexibility and family interaction, and improved morale. Telecommuting may offer new employment opportunities for the mobility limited and can aid rural development as distance from one's employer becomes less important to workers. This non-traditional model has proved difficult for some enterprises to adopt and adjust to, but has been largely successful for appropriate job functions.

Advances in telecommunications services and technologies further enable the development and success of telecommuting. The well-equipped home work area may have a second phone line, personal computer and the ability to fax and copy documents. A recent computer modem protocol, DSVD, allows simultaneous voice and data transmission over a single POTS line, perfect for telemarketing, catalog sales and other applications where one needs to converse while accessing data. Technologies such as ISDN further enable these applications with their faster data rates and ability to more rapidly transfer calls from site to site.

Nationwide 9.1 million people telecommute one or more days a week, a 20% increase over 1993's total of 7.6 million. There are 4.2 million additional telecommuters who are self-employed business owners with their primary place of business located outside the home for a total of approximately 13.4 million telecommuters working an average of 7 days per month at home. (Source: Find/SVP, 1994 American Information User Survey). In Maricopa County, almost 93,000 employees (8%) telecommute at least one day per week saving an estimated 600,000 miles of travel and 12 tons of pollution each weekday. (Source: WestGroup Market Research, 1994 Report on Maricopa County Telecommuting)

Lost in Cyberspace - Navigation Tools:

Vannevar Bush, science advisor to President Franklin Roosevelt, published an article in 1945 envisioning hypertext and multimedia. Only recently have those concepts been sufficiently actualized in broadly used products and environments. The Internet and its military/research precedents plodded along for decades involving a growing, yet still minuscule community in its text-based world of e-mail, file transfer and data retrieval. Only with the onset of the World Wide Web several years ago, with its graphic views and point-and-click navigation did Internet use explode to include an estimated 30 million U.S. users, adding to the many millions subscribing to consumer online services.

Even with its vastly improved graphical access, the Internet can remain a foreboding place. As a network of networks, the information content is maintained and delivered from tens of thousands of sites across the planet. Only now are comprehensive hierarchical directories and well-designed search engines reaching common and practical usage, but they often still require inordinate amounts of time and effort to sort through potentially relevant material to find what is needed and reliable. In the government and public policy arenas, what information there is available is often of high quality and utility. But in many other areas of interest, the signal-to-noise ratio (useful and reliable content as compared to useless or misleading) remains much too low. Traditional and new entrepreneurial publishers are establishing a solid presence and electronic journals often deliver timely, valuable information, but there's just too much "stuff" out there.

Software applications and agents will supersede browsers for much of our personal information gathering needs. Customized newspapers, the "Daily Me," will be delivered to your in box or "electronic doorstep." Intelligent agents or Knowbots will have a profile of our needs, preferences, budgets and resources and take "assignments" to visit a vast array of information resources, collecting and sifting data to prepare and present targeted results to us. Such capabilities (i.e., Telescript from General Magic) are being integrated to operating systems and applications for near-term viability.

> The Librarian daemon looks like a pleasant, fiftyish, silver haired, bearded man with bright blue eyes, wearing a V-neck sweater over a coarsely woven, tweedy-looking wool tie. The tie is loosened, the sleeves pushed up. Even though he's just a piece of software, he has reason to be cheerful; he can move through nearly infinite stacks of information in the Library with the agility of a spider dancing across a vast web of cross-references.
>
> "Yes, sir," the Librarian says. He is eager without being obnoxiously chipper; he clasps his hands behind his back, rocks forward slightly on the balls of his feet, raises his eyebrows expectantly over his half-glasses ...
>
> Neil Stephenson in Snow Crash, 1992

Education in the Information Age:

> It is my very strong belief that free connections to the National Information Infrastructure (NII) may not be enough. If we want young people to actively use the technology of the future so it becomes second nature to them, then we must go a step further and provide free usage of the telecommunications lines that will connect school children and young people to new sources of knowledge. The principle of "free" public education for all children is the bedrock of our democracy. Not cheap, inexpensive, or available for a fee but in its very essence "free." We believe in this basic American principle because we know its long-term value for society as a whole.
>
> A child or young person who gets an education of high standards and excellence becomes the worker you can depend on, a better citizen, and a stronger consumer. An early investment in education should have broad application in creating a rate structure for the future use of the NII. Educational institutions, large and small schools, libraries, literacy centers, early childhood centers, community colleges, and universities should have access and usage of these services. If we can't connect the NII with all educational institutions at once, then schools, libraries, and literacy centers should be at the top of the list. I believe that this early investment in education will provide a handsome and long-term economic return to business and to the nation as a whole.
>
> Richard Riley, U.S. Secretary of Education

Technology itself can't provide educational excellence, but it certainly can be utilized as a tool to aid and deliver it. The necessary technological literacy and skills for modern living and productive employment are best learned at an early age. Since the late 1970's and early 1980's, personal computers have been extensively deployed in K-12 and higher education environments. Eventually stand-alone systems were networked to form learning laboratories and share peripherals and resources. More recently, these learning tools have been connected to a wider realm of on-site resources (i.e., school library or administration) and through the Internet to the world at large. A recent study found that in 1995, 37 states provided a connection for their K-12 institutions to the Internet via a statewide education network, up from 29 states in 1993. Seventeen states support their educational networks as a separate budget line item. Federal, state and private funding for such statewide networks was more than $207 million in 1995 ($199 million from state allocations). The same study reports that 6% of Arizona school districts have direct Internet connections and 31% have local dial-in access. (Source: Quality Education Data "Networks Now 1995: A Survey of How Schools Use Telecommunications Networks in Education) Recently, some state Public Utility Commissions have been requiring BOCs to use excess earnings to link schools to the Internet.

The Arizona Department of Education provides local access to the Internet in Phoenix, Yuma, Tucson and Flagstaff through its AzEdLink program. Currently 3,000 users are supported and the department's World Wide Web site offers access to background on their visions and goals as well as access to many educational resources (see Arizona Projects and Activities of Note for more details). Beyond government provided funding, many private initiatives are surfacing to support educational goals through advanced telecommunications services. For example, AT&T has recently announced their Learning Network, a $150 million commitment to put all the nation's 110,000 K-12 schools on the information superhighway by the year 2000. AT&T Capital Corporation offers innovative financing programs for high-tech equipment, software, and even building wiring, with tax exempt lease/purchase as an alternative to bond issues. In California, America Online has offered to connect over 2,000 schools next year providing unlimited free access to its services. President Clinton recently announced that Tech Corps will become a primary means of bringing technology into the classroom by recruiting, placing and supporting volunteers from business to lend technical support to schools in their communities. Many other such opportunities for public-private partnerships will be forthcoming and Arizona needs coordinated efforts in identifying and responding to